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(12) **Patent:** (11) **CA 0857306**

(54) SEPARATION CELL AND SCAVENGER CELL FROTHS TREATMENT

(54)

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ABSTRACT:

CLAIMS: Show all claims

*** Note: Data on abstracts and claims is shown in the official language in which it was submitted.

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Tar sands, which are also known as oil sands and bituminous sands, are aggregates of sand, mineral and water impregnated with heavy petroleum. The largest and most important deposits of the sands are the Athabasca sands, found in northern Alberta, Canada. These sands underlay more than 13,000 square miles at depths of 0 to 2000 feet. Total recoverable reserves after extraction and processing are estimated at more than 300 billion barrels--just about equal to the world-wide reserves of conventional oil, sixty percent of which is in the Middle East. By way of comparison, the American Petroleum Institute estimated total United States oil reserves at the end of 1965 at 39.4 billion barrels.

The tar sands are primarily silica, having closely associated therewith an oil film. This oil varies from about 5 percent to 21 percent by weight, with a typical content of 13 weight percent of the total material. The oil is quite viscous--6° to 8° API gravity--and contains typically 4.5 percent sulfur and 38 percent aromatics.

In addition to oil and sand, the composition of the sands includes clay and silt in quantities of from about 1 to 50 weight percent, more usually 10 to 30 percent and a small amount of water in quantities of 1 to 10 percent by weight.

Several basic extraction methods have been known for many years for the separation of oil from the sands. In the so-called "cold water" method, the separation is accomplished by mixing the sands with a solvent capable of dissolving the bitumen constituent. The mixture is then introduced into a large volume of water, water with a surface agent added, or a solution of a neutral salt in water. The combined mass is then subjected to a pressure or gravity separation.

*

In the hot water method, the bituminous sands are jetted with steam and mulled with a minor amount of hot water at temperatures in the range of 140° to 210° F. The resulting pulp is dropped into a stream of circulating hot water and carried to a separation cell maintained at a temperature of about 150° to 200° F. In the separation cell, sand settles to the bottom as tailings and bitumen rises to the top in the form of an oil froth. An aqueous middlings layer containing some mineral and bitumen is formed between these layers. A scavenger step may be conducted on the middlings layer from the primary separation step to recover additional amounts of bitumen therefrom. This step usually comprises aerating the middlings as taught by K. A. Clark, "The Hot Water Washing Method," Canadian Oil and Gas Industries 3, 46 (1950).

It is the practice to combine these froths, dilute them with naphtha and centrifuge the diluted combination to remove more water and residual sand. The naphtha is then distilled off and the bitumen is coked to a high quality crude suitable for further processing. The present invention is directed to an improvement in the above-described hot water process and more specifically is directed to a process for treating the separation cell and scavenger cell froths. The invention is based on the discovery that the secondary recovery froth can be significantly upgraded in bitumen content by settling, thereby significantly reducing the water and mineral that must be separated in the subsequent centrifuging step.

It is particularly surprising that settling will upgrade the scavenger froth since the primary froth may not be so upgraded unless the froth emulsion is first broken by dilution and/or added chemical aids. The scavenger froth need not

be diluted or otherwise treated in order to bring about upgrading by settling.

Generally, with the present invention, the froths from a hot water process are treated as follows:

The secondary froth which is the froth from the scavenger zone, is settled in a settling zone to form a lower layer of settler tailings substantially reduced in bitumen content compared to the secondary froth and an upper layer substantially upgraded in bitumen content compared to the secondary froth. The lower layer and the upper layer are separately removed from the settler and the upper layer is mixed with the primary oil froth. The primary oil froth is the froth product from the primary separation zone. The mixture of primary froth and product stream can then be further processed by, for example, dilution with a hydrocarbon diluent miscible with the bitumen in the mixture and capable of lowering its specific gravity and centrifuging to remove any remaining water and sand from the diluent-bitumen product.

In one embodiment of the present invention, the lower layer from the scavenger froth settler may be recycled and added to the oil-rich middlings from the primary separation cell for feed into the scavenger zone.

In the above-described process in the settling step any type or combination of types of settlers may be used. For example, continuous mechanical thickeners or clarifiers consisting of a single-compartment cylindrical tank or basin with a sloping bottom, a conical central area over a discharge outlet, and rotating rakes that move the settled solids toward the center of the basin might be used. Tanks may be either

square or rectangular when space is limited or when a vast amount of settling area, combined with a high volume of relatively dilute flow, is required.

Also in the above described process in the diluting step, any diluent may be used so long as it is a hydrocarbon capable of dissolving the bitumen constituent of the particular stream treated and of substantially lowering its specific gravity. While hydrocarbons such as benzene, xylene, toluene, gasoline, kerosene, furnace distillates or diesel fuels and others may be used, petroleum naphtha is the preferred diluent.

The drawing schematically illustrates one embodiment of the present invention. The Figure shows the process utilizing settling of the secondary froth to upgrade bitumen content before addition to the primary froth preliminary to further treatment.

In the Figure, bituminous tar sands are fed into the system through line 1 where they first pass to a conditioning drum or muller 16. Water and steam are introduced from 2 and mixed with the sands. The total water so introduced is a minor amount based on the weight of the tar sands processed and generally is in the range of 10 to 40 percent by weight of the mulled mixture. Mulling of the tar sands produces a pulp which then passes from the conditioning drum as indicated by line 3 to a screen indicated at 17. The purpose of screen 17 is to remove from the tar sands pulp any debris, rocks or oversized lumps as indicated generally at 4.

The pulp passes from screen 17 as indicated by 5 to a pump sump 18 where it is diluted with additional fresh water from 6 and a middlings recycle stream 7. The diluted pulp is

then pumped via 8 to the primary separation zone 19. The settling zone in separator 19 is relatively quiescent so that oil froth rises to the top and is withdrawn via line 9 while the sand settles to the bottom as a tailings layer which is withdrawn through line 10.

A middlings layer which contains some oil that failed to separate is withdrawn from the cell through line 11 to a flotation scavenger zone 20. In this zone an air flotation operation is conducted to cause the formation of additional oil froth which passes from scavenger zone 20 through line 12 to a froth settler zone 21. An oil-lean water middlings stream is removed and discarded from the bottom of scavenger zone 20 via line 13.

In the settler zone 21, the scavenger froth forms into a lower layer of settler tailings which is withdrawn and recycled via 14 to be mixed with oil-rich middlings for feed to the scavenger zone 20 via line 11. In the settler zone an upper layer of upgraded bitumen froth forms above the tailings and is withdrawn through 15 and mixed with primary froth from line 9 for further processing.

Examples I through VIII

The following table shows the results of several runs conducted on air flotation scavenger froth from a hot water process. In each run tar sands of varying composition were mulled with water, flooded and flushed into a separation zone where a primary froth was formed and recovered. Oil-rich middlings were withdrawn from the settler and subjected to an air flotation to recover a secondary froth of the composition as indicated under the headings "Secondary Froth." This

TABLE I

	1	2	3	4	5	6	7	8
Secondary Froth								
Bitumen, Weight Percent	24.0	23.2	7.2	12.3	9.8	9.2	11.4	9.3
Mineral, Weight Percent	21.6	21.2	17.0	15.9	9.2	12.4	9.8	11.6
Water, Weight Percent	54.4	55.6	75.8	71.8	81.0	78.4	78.8	79.1
Settler Product								
Weight Percent of Secondary Froth	53	50	28	30	21	22	28	23
Bitumen, Weight Percent	44.9	46.5	26.0	40.7	46.5	42.6	41.7	40.6
Mineral, Weight Percent	15.3	12.6	14.7	15.0	9.1	12.8	17.2	13.8
Water, Weight Percent	39.8	40.9	59.3	44.3	44.4	44.6	41.1	45.6
Settler Tailings								
Bitumen, Weight Percent	5.2	4.5	2.6	5.9	0.9	1.6	1.8	1.9
Mineral, Weight Percent	27.2	28.1	17.5	16.2	5.0	12.1	14.3	14.5
Water, Weight Percent	67.6	67.4	79.9	77.9	94.1	86.3	83.9	83.6
Settler Residence Time, Minutes	16.5	14.6	13.5	30.0	39.5	37.5	36.6	29.4

The data presented in the Table show that froth from the scavenger cell can be upgraded to a product of a substantially greater bitumen proportion than the secondary froth. It was noted that primary cell froth was not upgraded by settling under the same conditions.

secondary froth was removed and pass d to a 150 gallon rectangular settler and was allowed to settle for the indicated residence times. A product was recovered from the settler and was determined to be of the composition indicated under "Settler Product."

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In the hot water process for treating bituminous tar sands which comprises: forming a mixture of the bituminous sands and water, passing the mixture into a separation zone; settling the mixture in the separation zone to form an upper primary bitumen froth layer, a middlings layer comprising water, mineral and bitumen and a sand tailings layer; separately removing the primary bitumen froth layer and the sand tailings layer; passing a stream of middlings layer from said separation zone to a scavenger zone and therein recovering a secondary bitumen froth; the improvement which comprises:

(a) settling said secondary froth in a settling zone to form a lower layer of froth settler tailings substantially reduced in bitumen content compared to said secondary froth and an upper product layer substantially upgraded in bitumen content compared to said secondary froth; and

(b) separately removing said lower layer of froth settler tailings and said upper product layer from said settling zone.

2. The process of Claim 1 which additionally comprises:

(i) adding the said upper product layer to the primary bitumen froth layer to form a bitumen mixture;

(ii) adding a diluent to said bitumen mixture; and

(iii) centrifuging said diluted bitumen mixture to remove residual water and mineral.

3. The process of Claim 1 in which the lower layer of froth settler tailings from Step (b) is added to the stream of middlings layer from the primary separation zone as a recycle stream into said scavenger zone.

4. The process of Claim 2 in which the lower layer of froth settler tailings from Step (b) is added to the stream of middlings layer from the primary separation zone as a recycle stream to said scavenger zone.

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5. A method of treating at least a portion of the middlings from a separation zone in a hot water process for treating tar sands which comprises:

(a) passing said portion of middlings from said separation zone to a scavenger zone;

(b) recovering a secondary oil froth in said scavenger zone;

(c) settling said secondary froth in a settling zone, to form a lower layer of froth settler tailings substantially reduced in bitumen content compared to said secondary froth and an upper product layer substantially upgraded in bitumen content compared to said secondary froth; and

(d) separately removing said lower layer of froth settler tailings and said upper product layer.

6. The method of Claim 5, in which the layer of froth settler tailings from Step (d) is recycled and added to the middlings passing to the scavenger zone in Step (a).

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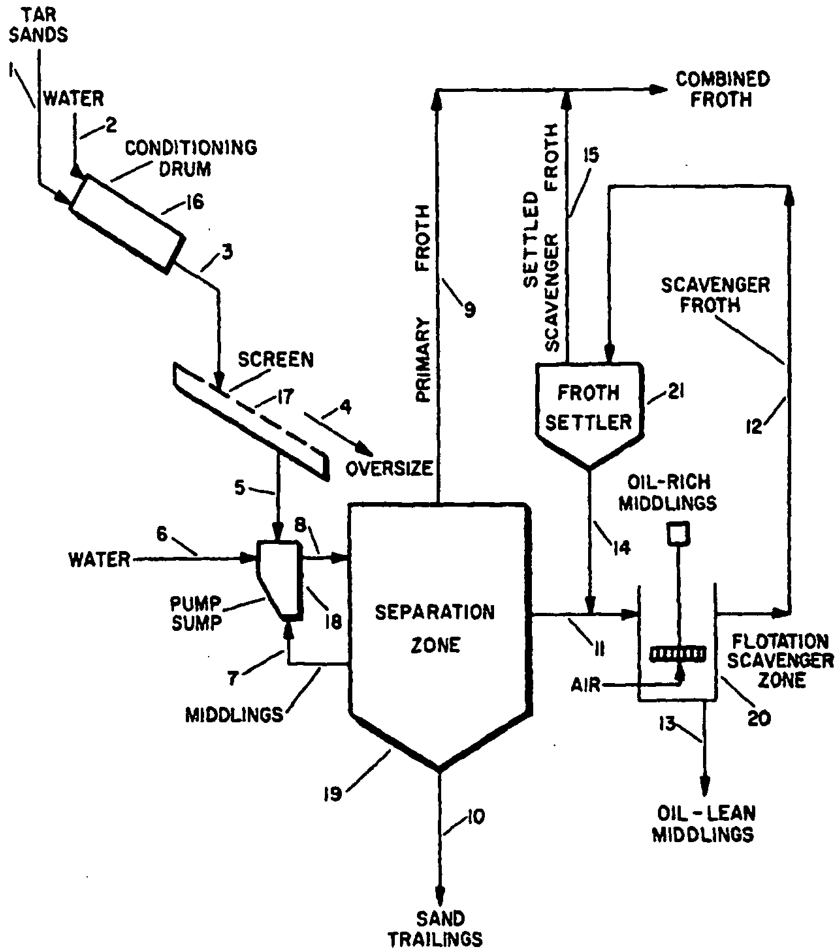

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